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## AQUIFER EXEMPTIONS: WISE USE OF ENVIRONMENTAL PROTECTION RESOURCES

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### ABSTRACT

The competition between ever-expanding environmental regulations and the ongoing decrease in environmental protection resources has prompted both regulatory agencies and industry to more closely examine the use of these limited resources. In the underground injection control (UIC) program, technical and managerial professionals from industry and government must at times evaluate whether or not certain ground water aquifers should be protected. If an aquifer exemption is clearly justified, the operator should not have to protect it, hence conserving valuable environmental protection resources. However, some state and federal agencies would prefer never to approve an aquifer exemption even though some are justified. This is apparent as the variations regarding how aquifer exemptions are processed by agencies seems largely to be resulting from the lack of clear guidance on aquifer exemptions and the lack of understanding for the term "reasonably expected" as intended by EPA and Congress. Because of the lack of positive instruction from state and federal agencies and a general lack of awareness on industry's part, the aquifer exemption process continues to be somewhat esoteric and often times misunderstood.

The purpose of the UIC Program as mandated by Congress is to protect underground sources of drinking water (USDW) being used in public water systems, as well as to protect potential USDWs where there is a reasonable likelihood that these sources will be needed in the future. However, Congress did not intend for EPA to protect all

potential USDWs. If it was reasonably expected that a potential USDW could not be used in the future as a public water system, protection of that aquifer would not be required. In fact, EPA affirmed that it would be a misallocation of resources to seek to protect as drinking water sources aquifers which in fact would not be used by public water systems. To ensure that such aquifers would not be protected, EPA developed an aquifer exemption process under 40 CFR 144.7 and 146.4 by which aquifers could be evaluated for their potential use as future public water systems. Government and Industry should utilize the aquifer exemption process as much as possible to ensure that the wise use of limited environmental protection resources is accomplished. The Clinton Administration appears to also endorse this position. In an April 1994 Letter to Congressman Earnest J. Istook on the domestic oil and gas industry, President Clinton stated: "we intend to help on the cost side... by reducing unnecessary and inefficient costs and regulations. I have challenged federal agencies to eliminate regulatory overkill and to attack regulatory barriers and subsidies here and abroad".

### INTRODUCTION

The competition between ever-expanding environmental regulations and the ongoing decrease in environmental protection resources has prompted both regulatory agencies and industry to more closely scrutinize these scarce resources. Both groups are beginning to more closely evaluate the effectiveness of how these resources are used, as well as assessing their relative benefits to the

environment. In today's world of environmental activism, it is essential that both regulators and industry groups focus the use of these scarce resources on the most sensitive environmental areas while also investigating areas in which resources are being expended with little or no benefit to the environment. These evaluation efforts are also becoming more and more focused on a national basis as opposed to a local or regional basis, which has typically been the case in previous years for both the industrial and the regulatory sectors.

In regard to the underground injection control program, there are many instances where industry is expending significant resources to protect ground water aquifers that may never be used to supply a public drinking water source because they: 1) occur at great depths; 2) may be remotely located; 3) are hydrocarbon or mineral bearing/producing; or 4) are otherwise not reasonably expected to serve as a domestic water supply. In fact, many of these aquifers contain ground water with total dissolved solids (TDS) concentrations exceeding 3,000 mg/L, which substantially exceeds drinking water quality standards for potable water supplies. Furthermore, regulatory agencies have committed substantial resources to permit, enforce, and verify that these saline aquifers are protected. Currently, this commitment of protection and resources is generally keyed on TDS concentration alone rather than whether or not a particular aquifer would ever be expected to be utilized for domestic use. Although such overly restrictive practices are ongoing today, it was not the intent of Congress or the United States Environmental Protection Agency (EPA) to necessarily and unequivocally protect all aquifers having less than 10,000 mg/L TDS, especially if they are not reasonably expected to be used by a public water system.

The issue most complex and subjective when attempting to demonstrate to agencies that an aquifer should not be protected is whether or not the aquifer(s) are reasonably expected to supply a public water system. Recognizing Congress' intent, EPA included an exemption mechanism within the main body of the regulations to address this particular issue. This exemption mechanism is the vehicle in which both industry and regulatory bodies can work together to assess whether or not an aquifer would meet the specific criteria developed through the regulatory development process to be an exempted aquifer. In fact, in 1983, EPA Headquarters developed a technical guidance document (EPA Guidance Document No. 34) which presented criteria to be used in the review of aquifer exemption petitions, further verifying the role of the aquifer exemption in the implementation of the UIC Program nationally and in determining the "wise use of environmental protection resources." Based upon review of the legislative and

regulatory history of the UIC Program's development from a national perspective, it was intended that aquifer exemptions not be made so difficult that they are never considered as a viable alternative. A detailed summary of the legislative and regulatory history of the aquifer exemption is presented in the next section of this paper.

By accepting the documented intent of Congress and EPA regarding aquifer exemptions, evaluation of whether or not a particular aquifer (or group of aquifers) should be protected becomes one that is technical in nature. This rather extensive and complex evaluation typically includes a demonstration that the aquifer(s) do not and are not reasonably expected to serve as a source of drinking water based on a number of factors including population density, short- and long-term availability of alternate supplies, aquifer depth, water chemistry of fluids within the aquifer, spatial variations in aquifer quality of water, as well as others. An extensive geologic and hydrogeologic investigative summary to define the hydrogeologic system in the area is typically performed, as well as a demonstration that by not protecting the subject aquifer, injection operations will not result in the contamination of existing underground sources of drinking water. The limits of the aquifer to be exempted must be clearly defined, with consideration given to the vertical and lateral extent of the exempted area. An analysis of environmental impacts resulting from the exemption as well as an analysis of the potential for public use of the subject aquifer usually requires an evaluation from both a technology and economic perspective (that is, is it practical to expect the subject aquifer to be used to supply a public water system?).

Although presentation of the technical criteria pertaining to aquifer exemptions is not the intent of this paper, it is evident that the petition process is currently quite complex. The process presently requires the expertise of multiple-skilled professionals with expertise and experience in water supply and treatment, ground water modeling, well construction and operation, physical and historical geology, hydrogeology, borehole geophysics, geochemistry, planning, economics, environmental regulations and environmental law.

Justifying aquifer exemptions were not so complex in the beginning. Earlier in the life of the UIC Program, aquifer exemption petitions underwent significantly less scrutiny because most were submitted as part of a primacy application by state regulatory agencies. However, through the environmental revolution we are now experiencing, an attitude has arisen that "stricter environmental protection is always better" and the wise use of environmental protection resources are simply being ignored. It has only been in

recent times that there has been broad questioning about how our limited environmental protection resources are being utilized. This recent awakening has since led many individuals involved in the UIC Program to re-evaluate the intent of these complex regulations, and how the aquifer exemption process can be used to determine whether aquifers should receive protection as an USDW in an effort to verify that our environmental protection resources are being used wisely.

### LEGISLATIVE AND REGULATORY HISTORY

To gain further insight as to the intent of Congress and EPA in regards to the definition of what are known as USDWs and the intended protection of these ground water aquifers, it is necessary to understand the legislative and regulatory history of the UIC Program. Throughout the development of the UIC Program, as with many other environmental programs, consideration of numerous issues were discussed, assessed, and scrutinized by members of Congress, EPA, state regulatory representatives, industry representatives, environmentalists, and others. Following is a detailed history of legislative and regulatory occurrences pertaining to the development of the UIC Program as we now know it. However, this summary is focused on the development of what is known as USDWs and the aquifer exemption process.

In 1974, the Safe Drinking Water Act (SDWA) was passed by Congress. Part C of the Act mandated that nationwide underground injection control (UIC) activities would be administered by EPA through individual UIC state programs. The Administrator was required under Section 1421(a)(1) to publish proposed UIC regulations within 180 days of enactment for these programs. Section 1421(b)(1) of the Act required UIC state programs to contain minimum requirements to prevent endangerment of drinking water sources. In the House Commerce Committee Report accompanying the statute, Congress made itself clear on how it wanted to protect water sources: "The Committee seeks to protect not only currently-used sources of drinking water, but also potential drinking water sources for the future. The Committee expects the Administrator's regulations at least to require States to provide protection for subsurface waters having less than 10,000 ppm total dissolved solids, as is currently done in Illinois and Texas, even though water containing as much as 9,000 ppm would probably require treatment prior to human consumption" (P.L. 93-523, Page 6484).

However, Congress did not intend for EPA to protect every underground source of drinking water (USDW), even if the total dissolved solids (TDS) level was less than 10,000 mg/L.

The Report states that the Act is intended to protect aquifers only "if there is any reasonable likelihood that these sources will be needed in the future to meet the public demand for drinking water and if these sources may be used for such purpose in the future." In other words, the Committee was affirming that the Act is intended to protect aquifers only if there is a reasonable likelihood that these sources will be used in the future to supply a public drinking water source.

The SDWA also mandated that EPA could not prescribe requirements which interfere or impedes underground injection in the states' UIC Program. Section 1421(b)(2) of the Act instructs EPA as follows: "Regulations of the Administrator under this section for State underground injection control programs may not prescribe requirements which interfere with or impede - (A) any underground injection of brine or other fluids which are brought to the surface in connection with oil or natural gas production or natural gas storage operations, or (B) any underground injection for the secondary or tertiary recovery of oil or natural gas unless such requirements are essential to assure that USDWs will not be endangered by such injection." The Committee adopted this "amendment expressing its intent not to authorize needless interference with oil and gas production. The Committee sought to assure that constraints on energy production activities would be kept as limited in scope as possible while still assuring the safety of present and potential sources of potable ground water." Regarding the Committee's discussion on the words "interfere or impede," they "did not intend to include every regulatory requirement which would necessitate the expenditure of time, money, or effort." The Committee "intended to refer to those requirements which could stop or substantially delay production of oil or natural gas." Accordingly, if a federal regulatory requirement substantially delays the production of oil or natural gas and is not essential to prevent the endangerment of an USDW, such requirement violates the intent of Section 1421. Therefore, using a federal UIC Program requirement to protect an aquifer that is not reasonably expected to be used in the future would interfere or impede oil and gas production and would not be in accordance with the intent of the Act.

The concept of "underground source of drinking water" and "aquifer exemption" were conceived by EPA when they began to study the Act and develop UIC regulations in 1975. Following is a detailed regulatory review of this development process by EPA over the life of the federal UIC regulatory program.

40 CFR PART 146 (41 FR 36730 - AUGUST 31, 1976)

EPA was required to publish proposed regulations within 180 days of enactment of the SDWA. It was approximately 1-1/2 years before the first proposal was published. In this proposal, EPA defined "USDW" with "exceptions." The exceptions would provide the Director justification for exempting aquifers from being designated as USDWs for protection under the UIC Program.

USDW Definition

In accordance with the Act, EPA proposed Part 146 of the regulations to govern state UIC Programs. One of the first issues to be addressed was the definition of an underground drinking water source, which the name was later changed to an USDW. EPA noted that the House Report provided guidance as to which drinking water sources should be protected. The Report declared that the Administrator should provide protection for subsurface waters containing 10,000 mg/L TDS or less. In addition, the Report instructed EPA to construe the term liberally; both currently-used and potential drinking water sources warranted inclusion in the definition. Section 146.2(g) defined USDWs as follows: "Except as provided in Section 146.11, "Underground drinking water source" means (1) an aquifer which currently supplies a public water system, or (2) an aquifer which contains water having less than 10,000 mg/L TDS."

Exceptions

Section 146.11 provided exceptions, so that certain water sources could be excluded from the USDW definition. Section 146.11(a) would not require a state to protect an USDW of less than 10,000 mg/L if it was oil producing, too contaminated for use, or located in such a way that use as a drinking source was impractical. Section 146.11(b) would allow states to designate whole geographical areas where no USDWs existed. EPA solicited comments on this approach to selecting aquifers which do not require protection as potential drinking water sources. It is memorable to note here that whole geographical areas could be exempted from the state UIC Program under these 1976 proposed regulations. Also, the regulations did not specify that injection into an aquifer was the only acceptable criteria for obtaining an aquifer exemption or that injection operations other than related to oil and gas would be precluded from the exemption process.

This proposed regulation specified that aquifers containing less than 10,000 mg/L TDS should be defined as USDWs. But, if there was a reasonable likelihood that a USDW would not be used in the future, protection of that aquifer

would not be required. EPA felt it was a "misallocation of resources to seek to protect as potential drinking water sources, aquifers which in fact will not be used by public systems," (Page 36733).

40 CFR PART 146 (44 FR 23738 - APRIL 20, 1979)

In 1978, EPA decided to consolidate the regulations for its major permit programs. Accordingly, the UIC regulations would appear in four parts-122, 123, 124, and 146. The Part 146 regulation proposed here would establish the technical criteria and standards to be used by EPA in state programs. This proposal states operators as well as state directors can petition EPA for exemptions.

USDW Definition

The House Report (P.L. 523) instructed EPA to include currently-used and potential drinking water sources in the definition of an USDW. Even aquifers which currently could not provide potable water would not be excluded. EPA expanded the definition in Section 146.04 to include all aquifers or their portions which are currently providing drinking water, and as a general rule, all aquifers or their portions with fewer than 10,000 mg/L TDS. The actual USDW definition was not published in this proposal, but later published as a proposal under 40 CFR 122.3, June 14, 1979.

Exceptions

EPA recognized that a numerical cutoff cannot always accurately establish which portion of aquifers have real potential to become USDWs. For example, a USDW of 10,000 mg/L TDS or less still might never provide potable water because of severe contamination other than in the form of dissolved solids. Similarly, aquifers which comply with the 10,000 mg/L TDS or less level may be located so far from any population centers or may be so far below the land surface as to make their potential for use as an USDW extremely remote. Consequently, EPA placed USDW exceptions in the 1979 proposed regulation. The exceptions under Section 146.04 read as follows: "The Director need not designate an aquifer or part thereof with fewer than 10,000 mg/L TDS if the aquifer or part thereof: (a) Does not currently serve as a source of drinking water; and (b) Cannot now and will not in the future serve as a source of drinking water because (1) It is mineral, oil, or geothermal energy producing; (2) It is situated at a depth or location which makes recovery of water for drinking water purposes economically or technologically impractical; or (3) It is so contaminated that it would be economically or

technologically impractical to render the water fit for human consumption."

#### Aquifer Exclusion

At that time, persons could petition for aquifer exclusions under the Section 146.4 exceptions. EPA states the intent of the exclusion of mineral, oil or geothermal producing portions of aquifers is to allow operators to continue production in existing aquifers undisrupted by these regulations. This made sense because Section 1421 (b)(2) of the Act mandates that EPA may not prescribe requirements that may interfere or impede underground injection unless such requirements are essential to prevent endangerment of USDWs. However, EPA pointed out that "the exemption is not intended as a green light to exempt any aquifer or its portion which merely has the potential to be used in the future for production purposes." However, EPA did acknowledge that operators may at any time petition the Director to exempt a portion of an aquifer that has future resource production possibilities. EPA considered placing limitations on exemptions of aquifers with future resource production, but instead requested comments on whether limitations would be desirable and whether they would interfere with or impede resource recovery.

EPA also solicited comments on the exemptions which dealt with whether an aquifer or its portion can reasonably be expected to be used as an USDW. EPA wanted to know if these exemptions were necessary or desirable. However, they had noted earlier in the Preamble that this exemption "approach makes it possible to avoid potentially burdensome requirements in specific instances when little environmental purpose would be served." At this point in time, EPA was addressing the intent of Congress to only require the protection of aquifers that can reasonably be expected to be used as an USDW.

In 1976, EPA carefully thought about subjecting only wells that inject into, through, or above drinking water sources to the UIC regulatory Program. However, they felt this proposal in some cases would leave an operator in a quandary as to whether a particular well was subject to the regulations. To avoid this problem, the 1979 proposal would apply to all injection wells.

#### 40 CFR Parts 122, 123, and 124(44 FR 34245 - JUNE 14, 1979)

These proposed consolidated regulations would revise Parts 122, 123 and 124 then used for the NPDES program under the Clean Water Act. As previously mentioned this consolidation would address four major permit programs

(UIC, RCRA, NPDES, 404). Part 122 would define the regulatory framework, Part 123 would define the elements of an approvable state program and Part 124 would describe the procedures for permit application and approval.

#### USDW Definition

The definition of USDW was not published in the 1979 40 CFR Part 146 proposal, but was referenced to in Section 122.3, which was published in this proposal. The definition read as follows: "USDW except as specified in Section 146.04 means: (1) an aquifer or its portion supplying drinking water for human consumption; (2) an aquifer or its portion in which the ground water contains less than 10,000 mg/L total dissolved solids; or (3) an aquifer or its portion designated as such by the Administrator or the Director."

#### Aquifer Exclusion

Under Section 122.33, States would have to designate those aquifers which are to be protected as USDWs and those which would not. The criteria for designation are addressed in Part 146.04. All aquifers would be designated as USDWs automatically unless specifically excluded. On page 34255, EPA discusses an important point on the aquifer exemption: "Any exclusion must define the excluded area in geographic terms rather than by name, to ensure that injectors have adequate notice as to whether or not they will be injecting above, into or through a designated USDW." This discussion points out that a state may exempt an area aquifer that operators are not injecting into, but are injecting through. Consequently, an operator could request that an aquifer be exempted from program protection even though he does not plan to inject into that aquifer. Furthermore, exemption criteria for aquifers not being used for injection were not being distinguished from those aquifers being used for injection during this regulatory development process.

#### 40 CFR PARTS 122, 123, 124, and 125 (45 FR 33290 - MAY 19, 1980)

This Final Rule established consolidated regulations for five permit programs, rather than four as first intended. An additional program, Prevention of Significant Deterioration (PSD) under the Clean Air Act, was added which was not addressed in the 1979 consolidated regulation proposal. There were modifications made in the Final Rule, but changes in the definition of USDW and in the aquifer exemption process were minimal.

### USDW Definition

The definition in Section 122.3 read as follows - An USDW means an aquifer or its portion: (a)(1) which supplies drinking water for human consumption; or (2) in which the ground water contains fewer than 10,000 mg/L "total dissolved solids;" and (b) which is not an "exempted aquifer." The definition changed somewhat from the previous proposed definition. What was to be designated by the Administrator or the Director as "excepted" aquifers in the 1979 proposal was replaced by the term "exempted" aquifers as defined in the 1980 final regulation under Sections 122.35 and 146.04.

### Aquifer Exemption

In Section 122.35(a), the Director may identify and shall protect, except where exempted as an USDW, all aquifers or parts of aquifers which meet the definition of USDW. Even if an aquifer is not identified by the Director, it is an USDW if it meets the definition under Section 122.3. The Director may identify "exempted aquifers." The term takes the place of the exceptions to USDWs formerly listed in proposed Section 146.04, which also appeared in the definition of USDW in proposed Section 122.3(a). The section also specified that "Such exempt aquifers are those which would otherwise qualify as USDWs to be protected, but which have no real potential to be used as drinking water sources." For an aquifer to be exempted, the Director must utilize the procedures in Section 122.35(b). After notice and opportunity for a public hearing, the Director may identify an aquifer or parts of an aquifer which he proposes to designate as an exempt aquifer using the criteria in Section 146.04. The Administrator would approve the aquifer exemption when the state submits its program for primacy approval. Identification of aquifers subsequent to state program approval would be treated as modifications under Section 123.6(b).

Finally, EPA agreed with commenters that the technical requirements of these regulations are not necessary when injection takes place far from any potential USDW and where the fluids are not likely to migrate into a USDW. In cases where injection does not take place into, through, or above an USDW, the Director may waive requirements for area of review, construction, monitoring and mechanical integrity under Section 122.43 - Waiver of requirements by Director.

### 40 CFR PART 146 (45 FR 42472 - JUNE 24, 1980)

The Final Regulations promulgated in the Federal Register established the technical criteria and standards that would

be used by state Directors. Included was the criteria for exempting aquifers from protection under these regulations.

### USDW Definition

The definition under Section 146.03 is the same as the definition under Section 122.3 promulgated in May 1980. Under Section 122.35, the Director, as part of the state program submitted for approval to EPA, may identify those aquifers or portions which will be considered as USDWs.

### Aquifer Exemption

In this Final Rule, an "exempted aquifer" is an aquifer which would otherwise meet the standard for an USDW but has been designated as "exempted" by the Director in conformance with Section 146.04. Basically, Section 146.04 states that a Director may designate an aquifer "exempt," which does not already provide water for human consumption but is capable of providing water of less than 10,000 mg/L TDS, if the aquifer is (1) mineral, hydrocarbon, or geothermal energy producing; (2) situated at a depth or location which makes recovery of water for drinking water purposes economically or technologically impractical; (3) so contaminated that it would be economically or technologically impractical to render it fit for human consumption; or (4) located over a Class III mining area subject to subsidence or catastrophic collapse. The first three conditions were changed very little even though EPA in 1979 requested comments on their concern about turning on the green light for exempting aquifers with the potential for producing future resources. EPA did not address that expressed concern as a part of this Final Rule. Also, their intent of exempting existing oil producing aquifers from being designated as USDWs to allow current production to continue undisrupted was left unchallenged. Only the fourth condition was new and was an attempt to address mining operation concerns.

EPA in the Preamble discussed the exemption process to be used by the Director in some detail. The Director could exempt aquifers as part of the state program he submits to EPA for approval. The Director was free to change the designations or add to them at a later date. Adding aquifers at a later date would constitute a major modification of the approved state program subject to comment and public hearing, as well as review and approval by EPA.

### API LITIGATION (AUGUST 1981)

The API litigated the UIC regulations promulgated in 1980. There were numerous issues addressed in the lawsuit. A settlement was reached on many of these issues including

the definition of USDW and the criteria for exempting aquifers.

#### USDW Definition

In the 1980 regulations, API pointed out that EPA rested its USDW definition on two categorical assumptions: (1) all drinking water sources currently in use regardless of location, ownership, quality, size, etc., can reasonably be expected to supply a public water system; and (2) all aquifers with water of less than 10,000 mg/L TDS can reasonably be expected to supply a public water system. EPA did not attempt to quantify or address in any detail the projected "likelihood" of these assumptions regarding public water systems. API pointed out that there are many water sources which do not supply water to a public water system because of their remote geographic location, their size, or their function for some other purpose. To subject every water source to the UIC regulations without regard to location, depth, size, function, endangerment, or likelihood of supplying a public water system was unduly burdensome and outside the intent of the SDWA.

#### Aquifer Exemption

API felt that Section 146.04, Criteria for exempting aquifers, was unduly stringent. They recommended this Section be modified (1) to provide in subsection (b) that an aquifer may be exempted if it "will not reasonably be expected to serve as a source of drinking water;" (2) to provide in subsection (b)(1) that mineral, hydrocarbon, or geothermal energy bearing aquifers may be exempted for Class II and Class III wells; and (3) to add a new subsection that would permit the exemption of an aquifer if alternative sources of drinking water are reasonably available to supply current and reasonably foreseeable drinking water needs.

#### 40 CFR PARTS 122 and 146 (46 FR 48243 - OCTOBER 1, 1981)

The EPA proposed numerous amendments to these regulations as part of a settlement agreement reached with a number of companies, trade associations, and the State of Texas which challenged the regulation in court. The USDW definition and the criteria for exempting aquifers were included in the proposed changes.

#### USDW Definition

After discussion with the litigants, EPA proposed to amend the USDW definition to more closely meet the intent of the SDWA. The agency addressed API's concern about public water systems, but ignored reducing the total dissolved solids

level below 10,000 mg/L. The definition was changed to the following: An Underground Source of Drinking Water means an aquifer or its portion: (1)(i) which supplies any public water system; or (ii) which contains a sufficient quantity of ground water to supply a public water system; and (A) currently supplies drinking water for human consumption; or (B) contains fewer than 10,000 mg/L total dissolved solids; and (2) which is not an exempted aquifer.

#### Aquifer Exemption

The agency believed that the use of aquifers containing water between 3,000 and 10,000 mg/L TDS was a function of economics and specific local hydrogeologic circumstances. The EPA proposed to provide flexibility to the Director for exempting aquifers. As a result EPA added a new criterion (c) to Section 146.04. The criterion read as follows: "The total dissolved solids content of the ground water is more than 3,000 and less than 10,000 mg/L and it is not reasonably expected to supply a public water system."

In the Preamble, EPA explained its position on this criterion: "As part of the flexibility afforded the Director subsequent to State program approval, such exemptions will not be considered program revisions." The Director after notice and opportunity for a public hearing, would notify the Administrator in writing of the designation and the exemptions would become final unless the Administrator disapproved of them within 45 days.

In the final regulation, the first criterion under Section 146.04(b) could have been construed as prohibiting mineral exploitation of previously unproduced areas. However, the Agency was still concerned about the wholesale exemption of large areas of the country simply because the aquifer was mineral bearing. EPA proposed a modification to allow the exemption of aquifers if they are expected to yield commercially producible minerals or hydrocarbons. In addition, Section 122.35 was modified to include detailed specific information the Director should require to make a judgment that an aquifer contains commercially producible hydrocarbons. The modification of Section 146.04(b)(1) read as follows: "it is mineral, hydrocarbon or geothermal energy producing, or can be demonstrated by a permit applicant as part of a permit application for a Class II or III operation to contain minerals or hydrocarbons that considering their quantity and location are expected to be commercially producible."

Exemption of aquifers under Section 146.04(b) would be treated as program revisions under Section 122.13. As mentioned previously, exemptions under 146.04(c) would become final if the Director submitted the exemption in



writing to the Administrator and the Administrator did not disapprove the designation within 45 days.

40 CFR PARTS 122 and 146 (47 FR 4992 - FEBRUARY 3, 1982)

The proposed amendments resulting from litigation were published as final regulations by the Agency. Included in these final regulations were the modified USDW definition and criteria for exempting aquifers. EPA reviewed certain comments on the proposed amendments in the Preamble; however, there were none that were substantive. The USDW definition and exemption criteria proposed in October 1981 were published unchanged in this final rule. Incidentally, these particular amendments to the regulations have remained unchanged until the present time.

40 CFR PARTS 144 and 145 (48 FR 14146 - APRIL 1, 1983)

This final rule deconsolidated the Consolidated Permit regulations for RCRA, UIC, NPDES, PSD, and 404. Most of the UIC Program requirements written in Parts 122, 123, and 124 were placed under new Parts 144 and 145. The intent was to make the regulations easier to understand and to use. This rule made no substantive changes to any of the affected Sections.

Part 124 sets forth the public participation requirements that must be met by UIC Programs in DI states.

Part 144 sets forth the permitting and other program requirements that must be met by UIC Programs administered by EPA (Direct Implementation (DI) states).

Part 145 sets forth the necessary elements of a state submission and the procedural requirements for approval of state programs. Presently, no state has applied for primacy under this Part; they applied under Section 1425 of the Act which allows states to obtain primacy under guidelines developed by EPA in May 1981.

Part 146 sets forth the technical criteria and standards that must be met in permits and authorization by rule as required by Part 144 in DI states.

40 CFR 124, 144, 146 and 147 (48 FR 40098 - SEPTEMBER 2, 1983)

This rule was proposed to address a state which had not submitted a UIC Program application or if the State program either had been disapproved or no longer met the

requirements of the Act. The agency was proposing regulations to establish UIC Programs in 23 jurisdictions.

Upon implementing a State program, the Director may designate and shall protect, except where exempted in 144.7(b), USDWs which meet the definition in Section 144.3. If an aquifer is not specifically designated as an USDW, it is an USDW if it meets the definition in Section 144.3 unless exempted. An aquifer exemption, which would otherwise meet the standard for a USDW, must be designated as "exempted" by the Director consistent with requirements in Section 146.4. An exemption would allow operators of Class II injection wells to inject into what would otherwise be an USDW. Further and just as importantly, EPA explained that "the absence of nearby USDWs may also result in lesser requirements being applied to the owner or operator." In other words if the Director or an operator could justify the exemption of all aquifers in a geographical area, the waiver under Section 144.16 could be used to lessen the UIC Program requirements in that area. In cases where injection does not take place into, through, or above a USDW, the Director may waive area of review, construction, monitoring and mechanical integrity requirements.

Since 1982, states have applied for primacy under Section 1425 of the Act. A number of states had already been delegated primacy prior to this proposal being published. EPA approved UIC Programs for states to use and enforce, but had not operated a UIC Program itself. As a result, designating aquifers as USDWs and approving aquifer exemptions had not been performed in DI states. In this proposal, EPA identified aquifers to be exempted before program approval, but recognized that in some cases additional aquifer exemptions may become appropriate after program approval. For state administered programs, the existing regulations in Section 144.7 affirmed that, generally, aquifer exemptions are program revisions. For program revisions that are "substantial," the program revision process under Section 145.32 must be utilized. For "non-substantial" revisions, a less formal process would be used, although the state must still provide public notice and opportunity for a hearing before submitting the request to EPA for approval. EPA explained that their experience with state administered programs indicated that some aquifer exemptions were "substantial" and others were "non-substantial."

EPA affirmed that the program revision concept for state administered programs under Section 144.7 did not necessarily apply directly to federally administered programs. However, EPA believed that a similar approach should be used. "For procedural purposes, to reflect the distinctions between substantial and non-substantial revisions described



above, EPA therefore would distinguish between "major" and "minor" exemptions." Major exemptions would be made by rulemaking procedures. Minor exemptions would be made without Federal Register publication, but public notice and an opportunity of hearing would be provided in all cases.

EPA defined major and minor exemptions. A major exemption was any exemption of an aquifer containing less than 3,000 mg/L TDS that is (a) related to any Class I or IV well; or (b) not related to action on a permit. All exemptions not defined as major would be considered minor. Minor exemptions would include all exemptions considered as a permit action which provides for public comment and opportunity for a hearing. Also considered minor exemptions would be those approved because the aquifer contains more than 3,000 mg/L TDS and is not reasonably expected to supply a public water supply system (See 144.4(c)). EPA felt this was consistent with the procedures for state administered programs where Section 144.7 places a 45-day time on EPA approval or disapproval of the exemption. Further, EPA affirmed that if any exemptions proposed under this criteria are not associated with a permit action, the Agency would still have to provide notice in the affected area and an opportunity for comment and a hearing just as normally provided in the permitting process. In summary, minor exemptions may or may not relate to a permit action, but in all cases, public comment and opportunity for hearing must be provided.

40 CFR 124, 144, 146, and 147 (49 FR 20138 - MAY 11, 1984)

In this rulemaking, EPA promulgated final regulations establishing UIC Programs in each of 22 jurisdictions for which no state administered program had been approved.

In the proposal, EPA described in detail the criteria for exempting aquifers and the administrative mechanisms to be used in granting various kinds of exemptions. The Agency reiterated that the minor exemptions would not be subject to the program revision process outlined in Section 145.32. Minor exemptions would include "... all exemptions considered as part of a single permitting action ..." and those exemptions that are for USDWs having greater than 3,000 mg/L TDS and not reasonably expected to supply a public water system" (48 FR 40108). EPA affirmed that the criterion of a single permitting action was chosen because it would ensure that the size of the exemption would be limited to the area around a single well or project and that the aquifer exemption proposal would be subject to public scrutiny in the public participation process. However, EPA had noted earlier in the September 1983 Preamble that if an

aquifer exemption was not associated with a permit action, EPA would still have to provide notice for public comments and a hearing just as normally provided in the permitting process.

The Agency, however, noticed that rule authorized injection wells would also need exemptions in some cases, because they would be automatically permitted when the state UIC Program was implemented. The "single permitting action" criteria would not apply to these type wells; consequently, the exemption process would have to be modified to account for this oversight. However, EPA determined that these types of exemptions would still be considered minor and not be subject to the rulemaking process. Minor exemptions related to rule authorized wells would be limited to a well or field. Further, the Agency would conduct the same public participation process for these exemptions as would apply to wells requiring a permitting action. This approach is consistent with the Preamble language at 48 FR 40108. The Agency confirmed that if any exemption was proposed under 146.4(c) and was not associated with a particular permit application, EPA would provide notice in the affected areas and an opportunity for comment and a hearing, just as normally provided in the permitting process. Exemptions of these types would not be triggered by a single permitting action.

Although additional federal registers for the UIC Program have been published since this last entry, there have not been any significant changes or modifications to the definition of an USDW or criteria for petitioning EPA for an aquifer exemption.

#### AQUIFER EXEMPTION ACTIONS IN THE UIC PROGRAM

Since 1982, the aquifer exemption process has been used by states when obtaining primacy for the Class II program and by EPA whenever they began directly implementing the Class II program in some 22 jurisdictions. There have also been some aquifer exemption actions in other areas of the overall program. Following is a brief history of certain aquifer exemption actions in the United States.

**CLASS II PROGRAM ACTIONS** - Since 1982, there have been several actions involving aquifer exemptions. All in all, there have been more than 600 aquifer exemptions granted in the United States.<sup>1</sup> The most common type of aquifer exemptions appear to be for either individual Class II injection wells or Class II injection well fields containing multiple wells, many of which were approved during state primacy application processes. For instance, EPA Region VIII approved a petition from the North Dakota Industrial

Commission, Division of Oil and Gas for the exemption of the Dakota/Lakota aquifers from the western border of the state to the Missouri River in the Williston Basin. Within this area, TDS concentrations ranging from approximately 2,500 mg/L to more than 10,000 mg/L exist in the Dakota/Lakota aquifers. Similarly, as part of the Nebraska Oil and Gas Conservation Commission's primacy application, EPA Region VII approved the exemption of the Dakota aquifer which covers more than 14 counties in aerial extent and the Hunton aquifer (part of which has waters with less than 3,000 mg/L TDS) which covers nearly an entire county. However, although exempted in much of the Williston Basin, the Dakota/Lakota aquifers are not exempted in the portion of the Williston Basin existing in eastern Montana, even though oil and gas producing operations and aquifer quality are essentially the same for both areas.

Due to the remote nature of many areas within Colorado, the state and EPA Region VIII have approved more than 100 aquifer exemptions. Similarly, there have been nearly 400 aquifer exemptions granted in Wyoming. In other states, aquifers having more than 2,000-3,000 mg/L TDS are many times regulated less stringently than aquifers reasonably expected to be used for domestic purposes. In fact, both the States of Texas and California do not protect aquifers containing ground water with TDS concentrations exceeding 3,000 mg/L with cemented surface pipe.

In Texas, the Railroad Commission established a formal procedure for aquifer exemptions early on. The Railroad Commission recognized that instances may exist where aquifers having less than 10,000 mg/L TDS cannot or will not in the future serve as a source of drinking water. These circumstances would exist when the depth and location make recovery of water for drinking water purposes economically impractical. The Commission also noted as early as 1981 that "economics can prohibit the producing and treating of water from an aquifer in comparison to developing alternative, abundant water sources in an area."

In 1982, the Railroad Commission was heavily involved in debating the intent of the SDWA concerning the endangerment of USDWs. Specifically, Section 1421(d)(2) reads as follows:

"Underground injection endangers drinking water sources if such injection may result in the presence in underground water which supplies or can reasonably be expected to supply any public water system of any contaminant, and if the presence of such contaminant may result in such system's not complying with any national primary

drinking water regulation or may otherwise adversely affect the health of persons."

In response to the above definition during their primacy application process, the Railroad Commission stated that "EPA chose to create a bifurcated approach to this simple concept of protection of ground water. First, EPA chose to define a USDW as water having a TDS of less than 10,000 mg/L. In using a specific number, EPA felt it was necessary to provide for aquifer exemptions for various categories. It should be noted that the aquifer exemption concept is part of the definition of USDW in the EPA regulations, and is part of EPA's attempt to clarify what is meant by USDW. Neither the 10,000 mg/L TDS limit nor the aquifer exemption concept are found in the statute, but rather both are concepts as part of EPA's attempt to implement the statutory language cited above." During their primacy application process, the Railroad Commission (as with many other state agencies) took a firm stance in regards to the definition of USDWs and aquifer exemptions. In fact, On March 29, 1982, the Regional Administrator of EPA's Region VI affirmed the Commission's practices regarding aquifer exemptions and ultimately approved the Texas UIC Program, further confirming the role of the aquifer exemption as a key factor in the implementation of any UIC Program.

In the mid-continent, the Oklahoma Corporation Commission has approved both regional (field-wide) and well specific aquifer exemptions for aquifers having more than 3,000 mg/L. In one case, an exemption was granted for an aquifer having less than 3,000 mg/L TDS near Ardmore, Oklahoma. All of the exemptions granted in Oklahoma were for intervals used for injection of fluids. In Oklahoma's case (as is the case in other states), it appears exemption of aquifers not used for injection has not occurred because most professionals involved in the UIC area have not considered the merits of this type of action from an environmental protection and environmental management standpoint.

Since the delegation of UIC Programs to state regulatory bodies, the practice of exempting certain aquifers has continued to play a critical role in the UIC Program. In Montana, it is well known that aquifers at great depths may contain ground water with TDS concentrations less than 10,000 mg/L. Many times, these aquifers contain ground water exceeding 3,000 mg/L TDS and are in such remote areas, the potential for domestic use is not practical. Furthermore, much of Montana's population which utilizes ground water as a source receives drinking water from shallow sources, typically having abundant supplies. To address these instances, EPA Region VIII has issued aquifer exemptions on a very limited and discrete basis and has

limited approval of exemption petitions to aquifers being utilized for active injection and a 1/4-mile radius around a well. In this instance, Region VIII has informally added two additional criteria to the aquifer exemption petition process (that is, the aquifer must be an active injection zone and exempted areas are limited to a 1/4-mile radius from the subject well), which is not appropriate based upon review of the legislative and regulatory history of the UIC Program.

**CLASS I AND V PROGRAM ACTIONS** - In Florida, the Florida Department of Environmental Protection and EPA in Region IV have approved two aquifer exemptions for a Class I injection well facility and a Class V well system. In each of these instances, detailed modeling was used to determine the extent of the aquifer exemption on an areal basis. This approach to addressing the extent of the exempted area is much more realistic than simply specifying a non-technically based area (for example, a radius of 1/4-mile), but often requires the use of a sophisticated 3-dimensional density dependent solute transport model. This can be especially important to enhanced recovery operations where formation flooding is projected to occur at distances greater than 1/4-mile from the subject well.

**AQUIFER STORAGE AND RECOVERY WELL ACTIONS** - Issues pertaining to aquifer exemptions are not just limited to Class I and II well types, nor are they limited to well types that are non-beneficial in nature. Throughout the country as well as in numerous other countries, the idea of cyclic storage and recovery of both potable and non-potable water is becoming a desirable technology to many cities and municipalities. Aquifer storage and recovery (ASR) wells (a Class V injection well) can be used to artificially facilitate ground water recharge during times when it is available, and recovery when it is needed to meet seasonal, long-term, emergency, or other domestic type demands.

Although stringent, regulatory constraints for potable water ASR have generally been achievable. However, for non-potable water ASR, the regulatory constraints represent a significant obstacle due to existing UIC regulations. For non-potable ASR, the objective is typically to store "raw" water into a brackish water aquifer for later recovery. For cases where ASR storage water does not meet drinking water standards, an aquifer exemption would be required, even if the ASR storage water was of higher quality than that of the natural water in the storage zone. Furthermore, this technology is critical in some areas of the country to meet the various types of demands presented above.

In many cases, because the ASR storage zone contains less than 3,000 mg/L TDS, permitting of the activity requires a "Major" aquifer exemption that must be approved not only

by the applicable EPA Region, but also EPA in Headquarters following publication in the Federal Register. Such a major exemption has never been issued for a Class V well. Not because it is not desired, but rather potential applicants have not been able to support such a major endeavor that may take several years to gain approval for without having some idea of the outcome.

This issue has not been significant to date since few water users have considered such ASR applications for storage of nonpotable water in brackish aquifers. However, this is rapidly changing. In Florida, South Carolina, Texas, California, Oregon, Iowa, and possibly other states, water users are beginning to recognize the potential advantages of being able to store large volumes of high quality, seasonally available water in brackish aquifers for irrigation and raw water supply purposes. A few aquifer exemption petitions are being prepared and submitted now, while others are still being considered. It will be unfortunate if these applications are tied up for several years as a result of the UIC aquifer exemption process and a general unwillingness of EPA to approve an aquifer exemption of any type.

**SUMMARY** - Presently, a number of state and federal agencies now utilize discretion when regarding the strict protection of those aquifers not reasonably expected to be used for domestic purposes. On the other hand, some state and federal agencies have made the aquifer exemption process overly burdensome and have added additional stipulations to the criteria developed by EPA through the regulatory process, even though no new applicable federal regulations have been promulgated. In fact, some EPA Regions would prefer never to issue an aquifer exemption, even though allowed by law.

As is evident, the application of aquifer exemptions applies to every well type, with each well type having distinct complexities and challenges. However, similar to each well type is the fact that the aquifer exemption is an integral part of the definition of a USDW and will continue to play a role in the UIC Program for the foreseeable future. The continued close evaluation of how environmental protection resources are used and what are resultant benefits should lead industry to more seriously consider the application of the aquifer exemption process and will in turn drive EPA to further re-evaluate the existing process nationally.

## CONCLUSIONS

Based on the regulatory development of the UIC Program as summarized above and implemented throughout the United States, the aquifer exemption process is a legitimate and useful means of assessing whether or not a ground water aquifer should be protected under the UIC Program. If an

aquifer exemption is clearly justified, an operator should not be required to unnecessarily protect it and waste valuable environmental protection resources so scarce in today's economy. However, some EPA Regions would prefer never to approve an aquifer exemption even though some are justified. This is apparent as the variations regarding how aquifer exemptions are treated by agencies seems largely to be resulting from the lack of clear guidance on aquifer exemptions, and the lack of an understanding for the term "reasonably expected" as used in 40 CFR 146.4 and intended by Congress as described in its Report. Because of a lack of positive instruction from state and federal agencies and a general lack of awareness on industry's part, the aquifer exemption process continues to be somewhat esoteric and often times misunderstood. This general lack of understanding has resulted in the unnecessary expenditure of scarce environmental protection resources, which likely could have been better utilized in other regulatory areas. The legislative and regulatory history provided in this paper should serve to clarify the intent of Congress and EPA on a national basis as well as help to clarify the regulatory exemption process.

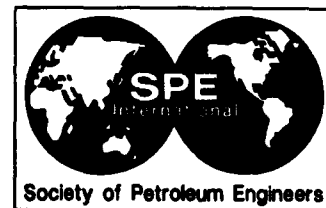
Further, clarifying the aquifer exemption process will assist Agencies and Industry in addressing new UIC regulations scheduled for promulgation by EPA in 1996. These new regulations will require operators to perform area of review (AOR) evaluations on certain Class II injection wells. As a result, some operators will again be confronted with the question of whether or not certain ground water aquifers within projects, fields, or basins should be protected under the UIC Program. If these aquifers need not be protected and an aquifer exemption can be obtained, the operator in certain circumstances should be able to acquire a variance from performing AOR evaluations on applicable wells from the state or EPA Director. To obtain an aquifer exemption, operators must presently use the aquifer exemption process in 40 CFR 144.7 and 146.4 as discussed in this paper. If the operator can demonstrate that any aquifer(s) are not reasonably expected to be used as a public water supply system, they can be exempted by the EPA Director with few exceptions. Clearly, the aquifer exemption process must continue to play a role in the UIC Program as a control mechanism to regulate the unwise use of scarce environmental protection resources.

Lastly, the Clinton Administration also endorses this position. Mr. Clinton has voiced a desire that federal agencies' pledge to cut back on regulations which create hindrances to oil and gas production. In an April 14, 1994 letter to Congressman Earnest J. Istook, President Clinton affirmed his Administration's commitment to reduce cost and identify regulatory burdens on the domestic oil and gas industry. In the letter he states: "...we intend to help on the

cost side... by reducing unnecessary and inefficient costs and regulations. This supports our overriding goal, which is to improve the effectiveness of how our nation produces and uses energy, creates jobs and enhances the quality of life for all Americans. I have challenged federal agencies to eliminate regulatory overkill and to attack regulatory barriers and subsidies here and abroad...". This commitment by Mr. Clinton will hopefully ensure that the aquifer exemption process is used to its fullest extent by EPA to preserve the Nation's scarce environmental protection resources.

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<sup>1</sup>This information was gathered through personal conversations with state and federal regulatory personnel and includes exemptions for all well classes.



**SPE 29761**

## **ENHANCING AREA OF REVIEW CAPABILITIES: IMPLEMENTING A VARIANCE PROGRAM**

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### **ABSTRACT**

The Railroad Commission of Texas (RRC) has regulated oil-field injection well operations since issuing its first injection permit in 1938. The Environmental Protection Agency (EPA) granted the RRC primary enforcement responsibility for the Class II Underground Injection Control (UIC) Program in April 1982. At that time, the added level of groundwater protection afforded by an Area of Review (AOR) on previously permitted Class II wells was not deemed necessary or cost effective.

A proposed EPA rule change will require AORs to be performed on all pre-primacy Class II wells unless a variance can be justified. A variance methodology has been developed by researchers at the University of Missouri-Rolla in conjunction with the American Petroleum

Institute (API). This paper will outline the RRC approach to implementing the AOR variance methodology.

The RRC's UIC program tracks 49,256 pre-primacy wells. Approximately 25,598 of these wells have active permits and will be subject to the proposed AOR requirements. The potential workload of performing AORs or granting variances for this many wells makes the development of a Geographic Information System (GIS) imperative. The RRC has recently completed a digitized map of the entire state and has spotted 890,000 of an estimated 1.2 million wells. Integrating this digital state map into a GIS will allow the RRC to tie its many data systems together.

Once in place, this integrated data system will be used to evaluate AOR variances

for pre-primacy wells on a field-wide basis. It will also reduce the regulatory cost of permitting by allowing the RRC staff to perform AORs or grant variances for the approximately 3,000 new and amended permit applications requiring AORs each year.

## **BACKGROUND AND INTRODUCTION**

The Safe Drinking Water Act (SDWA) of 1974 required the Environmental Protection Agency (EPA) to develop minimum requirements to establish effective state programs to protect underground sources of drinking water (USDWs) from contamination resulting from the subsurface injection or disposal of wastes. When the Underground Injection Control (UIC) regulations were promulgated in 1980, previously permitted Class II injection wells were excluded from Area of Review (AOR) requirements. EPA has expressed its intent to revise the regulations to include the requirement for AORs for such wells.

A Federal Advisory Committee has recommended that AORs for existing wells, not previously subject of that requirement, be performed within five years of promulgation of amended UIC regulations. The Federal Advisory Committee, however, recognized that conditions can exist that make it unnecessary to perform well-by-well AORs and that allow wells in a basin, producing trend, region or field or a portion of such areas to be exempted from an AOR through a variance program. The Federal Advisory Committee, in its recommendation that AORs be performed for pre-primacy wells, identified several situations that may prevent the migration of formation fluids into USDWs even in the presence of inadequately plugged wells.

A methodology for identifying areas that would be eligible for variance from AOR requirements based upon the Federal Advisory Committee criteria has been developed by a research team in the School of Mines and

Metallurgy at the University of Missouri-Rolla under sponsorship of the American Petroleum Institute (API) and subsequently has been endorsed by the Ground Water Protection Council (GWPC). The AOR variance methodology developed at University of Missouri-Rolla<sup>1</sup> has been applied to 24 oil fields undergoing injection in the San Juan Basin of New Mexico and is currently being applied to injection fields in selected counties of the Permian Basin in West Texas under sponsorship of the API. Work is also being initiated by University of Missouri-Rolla under a grant from the U.S. Department Of Energy (DOE) in four selected counties of the East Texas field, the historically largest U.S. producer, which was discovered in 1930.

The Railroad Commission of Texas (RRC) has regulated oil-field injection well operations since 1938, when the first injection permit was issued. The RRC currently tracks 80,829 injection and disposal wells in Texas (as of January 3, 1995). Of these, 49,256 wells were authorized to inject or dispose prior to the RRC program receiving primary enforcement responsibility from the EPA in April, 1982. These pre-primacy wells fall into three groups: 1) wells that have been plugged or taken out of injection service over the intervening years (22,265 wells); 2) wells that are continuing to operate under their pre-primacy permits and have not had AORs (17,704 wells); and 3) wells that have had post-primacy permit amendments (9,287 wells) that may have triggered AOR requirements. A survey of post primacy permit amendments indicates that an estimated 85% will have been too minor (e.g. changes to permitted injection pressures, volumes, or fluid types) to require AORs at the time, adding an estimated 7,894 wells to the number of pre-primacy wells that have not had AORs. A total of 25,598 wells are therefore potentially subject to the proposed AOR requirements.

The RRC plans to implement an AOR variance program in Texas. The RRC will lead a project management team consisting of

industry representatives from major and independent operating companies, and other appropriate participants. The DOE and API will be involved as participants or observers.

#### DISCUSSION OF VARIANCE CATEGORIES:

##### Variance based on absence of USDW:

This criterion allows variances in areas where there is no usable quality groundwater to be contaminated.

This approach is likely to play only a minor role in the variance process in Texas because approximately 76% of the state is underlain by either a major or minor aquifer. The remaining 24% of the state may have locally available groundwater<sup>2</sup>. The Texas Natural Resource Conservation Commission (TNRCC), which makes surface casing setting depth recommendations to protect usable quality groundwater, recommends surface casing be set for groundwater protection in virtually every well. In areas where the TNRCC considers that no groundwater exists, it recommends that 100 feet of surface casing be set for the protection of surface water runoff.

##### Variance based on negative flow potential:

This criterion allows variances in areas where the injection reservoir pressures are inadequate to raise formation fluids high enough to reach a USDW.

Evaluation of this factor provides many potential benefits to the Commission and industry. There are many sources of data available to perform this variance evaluation, but they have never been consolidated into a reservoir information database. Investigating this variance criterion presents the opportunity to consolidate data from the various

sources, creating a database of reservoir depths and engineering parameters. Such a database would be valuable to the Commission as well as to industry, both for use in this variance program, and for other uses.

##### Variance based on mitigating geological factors:

This criterion allows variances in areas where geological factors present flow impediments between the reservoir and the USDW.

This approach will require the most detailed technical review, but has significant long-term benefits in terms of justifying ongoing variances and reducing permitting requirements in areas where factors such as sloughing formations, heaving shales, or lost circulation zones may act as barriers by sealing the wellbore against flow of formation fluids or diverting those formation fluids into other zones.

##### Variance based on well construction and abandonment methods:

This criterion allows variances based on adequacy of well construction and abandonment practices to protect USDWs. The variance methodology developed at the University of Missouri-Rolla also details statistical methods that can be used to limit workload by sampling a representative group of wells rather than the entire population.

Evaluation of this factor will require well-by-well evaluation of at least a sampling of wells in a potential variance area. This process will require automation to reduce staff time to a minimum, but once set up will provide ongoing benefits to the Commission and industry. Once implemented, an automated wellbore review process will allow staff to perform AORs on new and



amended permit applications, and to require operator research only in areas where RRC records are lacking and the potential for groundwater contamination exists. Public access to this data could be provided by a GIS work station located in the RRC records department to allow operators, consultants, or members of the general public to perform their own AORs or other research using RRC data. Additional plans involve potential Internet access to RRC data.

A detailed review of RRC plugging requirements over time will facilitate variances based on plugging requirements. Known plugging requirements would allow a statistical sampling of wells plugged to various regulatory standards. The resulting stratified grouping of wells would increase the likelihood of at least part of the wells being excluded from consideration based on adequacy of plugging. This would leave a smaller group of older wells to be reviewed through well-by-well methods.

Appendix 1 summarizes RRC plugging requirements over the years. This summary indicates that wells plugged after 06/01/64 are most likely to be excluded based on this criterion alone, wells plugged between 02/01/34 and 06/01/64 are not as likely to be excluded, and wells plugged before 02/01/34 are least likely to be excluded. Statistical evaluations will require a statistically significant number of wells in each grouping of wells, so this level of stratification may not be possible in many areas.

Variance based on other compelling evidence: This criterion allows variances in areas where other factors will prevent USDW contamination. This

criterion is intended to allow any other factors that can be technically justified to be considered. Use of this criterion will rely heavily on industry input.

One possible method would be to assign "point values" to various "less than ideal" flow barriers in a well. One "point" would be equivalent to a barrier that could be consistently relied upon to block one psi of formation pressure. This method would allow partial barriers of different types to be counted together to provide variances where no one method alone would succeed. The likelihood of USDW contamination would be low enough to justify a variance if the cumulative barrier "points" exceed the formation pressure.

This point system would require a great deal of careful evaluation of the various points to be assigned to various types of flow barriers. The point values assigned to various flow barriers should be agreed to by all the AOR project management team members and should represent minimum limits for pressure blockage by various barriers. The initial point values would likely be very conservative estimates to which all parties can achieve a consensus, but could be revisited and refined later as more experience and data becomes available or additional research is performed.

#### EXISTING DATA SYSTEMS:

Hardcopy records: The RRC began collecting well casing and plugging records in 1919. Since that time, approximately 115 million well records have been collected on an estimated 1.2 million wells. Although most recently filed records are available electronically, most older records are accessible only in paper, microfilm, or microfiche formats.

Existing computer capabilities: The RRC has extensive data management systems in place. Existing data systems contain monitoring and testing information on 80,000 current and historical injection and disposal wells; well construction records on 670,000 current and historical wellbores; production records on 380,000 active and shut in wells on the current proration schedule; 400,000 drilling permits; 65,800 current and historical oil and gas fields; 145,000 current and historical producing leases; and a statewide map with over 890,000 mapped well locations.

The RRC created the "wellbore" database in 1962 by converting a well card collection to electronic well records for all currently active wells. Wells not currently active, with few exceptions, were not researched and added because of staff limitations. This database forms the basis of the current well construction database to be used in the AOR variance process.

The RRC has required mechanical integrity demonstrations for various categories of shut-in production wells since June 1993. The most common method of demonstrating mechanical integrity in these wells is measuring the static fluid level in the shut-in well. These reported formation static fluid levels form a database of current formation pressures that can be used to supplement and validate data reported on permit application forms. The RRC has over 12,200 fluid level tests in its statewide database, with 25,000 more shut in well tests due in June 1995.

In 1984, the RRC began the process of digitizing its well location maps into a Mapping Information Management System (MIMS). The first phase of the project was completed on September 30,

1994 when the land survey base map for the entire state was completed. Texas has 216 oil and gas producing counties, of which 171 have already had well location maps digitized as of January 1, 1995. A total of 894,448 well locations have been spotted. More importantly, however, the 171 digitized counties contain 93% of all the state's injection and disposal wells. The MIMS project is expected to complete the digitized well location maps in 1995.

Other RRC data sources: A series of biannual reports entitled "A Survey of Secondary and Tertiary Recovery Operations in Texas," which the RRC last published in 1982, are still highly sought information resources. These reports contained reservoir and production data from these operations and will be an easily accessible source of reservoir engineering parameters for use in reservoir pressure evaluation. The 1970 through 1982 reports are stored on 9-track magnetic tape and can be converted to a PC database in the variance review process. The conversion is likely to be time consuming, but once in a database format, the reports will become much more readily available to industry.

During the variance review process, the reservoir data filed on injection permit application forms (Form H-1), should be key entered to allow automation of the flow potential calculations. This will also have the effect of creating a reservoir information database to complement and update the biannual surveys.

Data from other agencies: Several other state agencies have data that will be valuable in evaluating groundwater effects on AOR variances. The Texas Natural Resource Conservation Commission (TNRCC) maintains an

computer database of water wells in the state. The Texas Water Development Board (TWDB) maintains a digital map of major and minor aquifers in the state. Both agencies have extensive libraries of reports of groundwater occurrence and quality in counties, river basins, etc. In addition, the TWDB published a report in 1972<sup>3</sup> which contained reservoir name, depth, porosity, and permeability data for most counties. The report can be scanned into a digital image system and then converted to a database format using Optical Character Recognition (OCR) software.

rely heavily on project management team members in areas such as: 1) identification and evaluation of geologic formations that may act as barriers to fluid flow; 2) evaluation of the effectiveness of historical plugging methods such as the use of "mud-laden fluid" and 20-foot cement plugs; 3) identification and evaluation of factors that can qualify as "other compelling evidence" for AOR variances; and 4) provision of data from industry sources to fill gaps in RRC data systems.

#### IMPLEMENTATION OF THE VARIANCE PROCESS:

##### HARDWARE AND SOFTWARE NEEDED:

The RRC currently operates under three automation platforms, which include mainframe, mapping (MIMS), and personal computer (PC) networks. When data resides on different platforms, data analysis is limited and often requires access to different workstations and manual correlation.

The integration of the three processing platforms can be achieved through conversion of its MIMS information into a GIS format and use of client/server technology. Integration of the three main data systems into this type of seamless database will allow analysis of data from various sources to support the technical decision-making process through a location-based inquiry system. The RRC plans to implement a GIS have been delayed by lack of funding. A grant proposal for data management hardware and software needs has been submitted to the U.S. DOE.

The first stage of implementing an AOR variance program will be the enhancement of the RRC's data processing capabilities. Once the data infrastructure is in place, data research and correlation can begin.

Formation of a project management team: The RRC will act as the coordinating agency for this project, and will lead a project management team consisting of the RRC; appointed industry representatives; and other appropriate participants. The DOE and API would be involved as participants or observers.

Data research and correlation: Many data elements needed to support AOR variances or to perform AOR evaluations, such as reservoir characteristics, are readily available in paper or microfilm files, but have not been entered into electronic systems. Ideally, this data will be entered as part of the AOR project. This information will be of great value to industry as well as the RRC. Entry of this data will also allow the RRC to identify and assign API numbers to the large number of historical wells drilled prior to 1962,

##### ISSUES TO BE RESOLVED BY AOR PROJECT MANAGEMENT TEAM:

The RRC AOR variance program will

when the API numbering system was initiated in Texas. All wells in the RRC "wellbore" database have at least a temporary API number, but wells taken out of service before implementation of the database have never had API numbers assigned.

Data entry needs could be addressed through the hiring of temporary data entry personnel. Data entry needs could also be addressed through the use of image scanning equipment that could create digital image records of RRC documents for display on computer systems. This scanning equipment could be augmented by a Compact Disc (CD-ROM) recording and viewing system to make these large amounts of data available on-line. A CD-ROM system would allow the RRC to store scanned images of oil and gas well logs for quick access and analysis. A CD-ROM system would also allow the RRC to publish large amounts of completion, production, well-logging, and mapping data at low cost to industry, other agencies, or the general public.

AOR variance methodology in known low-risk oil fields: The RRC's 75 years of oil and gas regulatory experience, coupled with the proposed team effort, would allow RRC staff to quickly identify areas likely to meet EPA's AOR variance criteria. These areas could then be evaluated using the AOR variance methodology developed by Dr. Warner in conjunction with API, to expedite AOR variances.

Sequence of variance methods: The implementation of a variance methodology would continue with application of each variance method to fields and/or reservoirs in a target area in the following sequence: 1) absence of USDW; 2) negative flow potential; 3) well completion and abandonment

methods; 4) mitigating Geological Factors; and 5) "other compelling evidence."

Data enhancement in other areas: The AOR variance process will identify areas with significant potential for USDW contamination. Since these areas represent the highest risk of pollution, every effort will be made to enter historical well and reservoir data to facilitate future AORs and pollution investigations. This data will also simplify evaluation of new and amended injection permit applications.

The RRC would also seek funding for research efforts in areas where additional study is likely to result in an AOR variance. The RRC would have the responsibility to approve AOR studies done by industry and/or independent researchers to ensure accuracy and consistency.

## SUMMARY

Implementation of an AOR variance program will provide significant benefits to the RRC. The data infrastructure enhancements necessary to implement the program will have wide ranging use throughout the RRC and will facilitate agency planning. The identification of areas with high risk of pollution will allow existing staff to more efficiently concentrate its efforts wherever the risk to groundwater is greatest.

Implementation of a variance program by the RRC also presents several benefits to the oil and gas industry. Chief among these is the reduction of regulatory costs through reduction of permitting requirements in low-risk areas. Another benefit will be the improvement in the quality of public well records available to industry. The correlation of the various formation/reservoir data sources needed to implement the variance program will make the

resulting database available to industry. The data system infrastructure enhancements will make the RRC's data systems more easily accessible to industry and the general public alike.

#### **REFERENCES**

1. Technical Criteria for an Area-Of-Review Variance Methodology, Underground Injection Practices Research Foundation, 1994
2. Ground-Water Quality of Texas - An Overview of Natural and Man-Affected Conditions, Texas Water Commission, Report 89-01, Plate 3 (From Univ. of Tx., Bur. of Econ. Geol.: Energy Resources of Texas, 1976)
3. A Survey of the Subsurface Saline Water of Texas, Texas Water Development Board: Report 157, 1972

## APPENDIX 1 HISTORY OF RRC PLUGGING STANDARDS

### GENERAL:

- \* Plugging of abandoned wells has been required since 1899.
- \* A plugging report must be filed after any well is plugged (required since July 26, 1919).
- \* A well must be filled with mud-laden fluid from total depth to ground surface (required since July 26, 1919).
- \* File intent to plug notification with log and casing record attached (required since July 26, 1919).
- \* Plug wells in such a way as to confine oil, gas, and water to the strata where they occur (required since November 12, 1921).
- \* Protect "fresh water" in general (required since March 1, 1923).
- \* Plug inactive wells (required since February 1, 1934). (Initially 20 days after production ceases, currently 1 year.)
- \* Cement plugs must be set through tubing or drill pipe under circulation, i.e. pump and plug method (required since February 1, 1934).
- \* Cement plugs required above high pressure gas or water zones (required since February 1, 1934). (Initially 20 foot centered on top of zone, today 100 foot centered on top of zone.)
- \* Set and cement surface casing through all fresh water sands (required since May 30, 1957).
- \* File a completion report (Form W-2) within 30 days of completion, deepening, or workover (circa May 30, 1959)

### SPECIFIC REQUIREMENTS AND SOURCES:

#### Passage of HB 542, March 29, 1899:

- Set casing to exclude fresh water from oil and gas zones.
- Place "rock, sediment, or mortar" ("mortar" = 2 parts sand, 1 part cement) plug to at least 200 feet above top of zone.

#### Rules and Regulations: OIL AND GAS CIRCULAR #7, June 18, 1919:

- Rule 5 defined commercial quantities of gas as "any gas stratum showing a well defined gas sand and producing gas."
- Rule 8 required intent to plug notification:
  - must include log of well;
  - file at least 5 days prior to plugging.
- Rule 9 required immediate plugging of abandoned or dry wells:
  - stipulated that "All dry or abandoned wells must be plugged by confining all oil, gas, or water, in the strata in which they occur, by the use of mud-laden fluid, and in addition to mud-laden fluid, cement and plugs may be used."
  - the mud-laden fluid must "weigh at least 25 per cent more than an equal volume of water" (10.4 ppg for fresh water, 12 ppg for heavy brine).
- Rule 10 required that an operator must file a complete record or log of the well upon completion of the well.
- Rule 20 requires protection of fresh water from pollution.
- Rule 25 requires the immediate plugging of any well with "irreparable injury" to the well

or to the oil or gas sand.

Passage of SB 350: OIL AND GAS CIRCULAR #11, July 26, 1919:

- Rule 5 defined commercial quantities of gas as "any gas stratum showing a well defined gas sand and producing gas."
- Rule 9 required intent to plug notification:
  - must include log and casing record;
  - file at least 24 hours prior to plugging.
- Rule 10 stipulated the method of plugging and required that "dry or abandoned wells be plugged in such a way as to confine oil, gas, and water in the strata in which they are found and prevent them from escaping into other strata."
  - Plugging by the use of mud-laden fluid or other method approved by the Commission.
  - Cement and plugs may be used for cable tool wells.
- Rule 11 required filing of plugging report and log.
- Rule 17 defined mud-laden fluid as 25 % mud (10.4 ppg for fresh water, 12 ppg for heavy (9.62 ppg / 270,000 TDS) brine).

OIL AND GAS CIRCULAR #12, March 1, 1923:

- Intent to plug notification required:
  - must include log and casing record;
  - three (3) days in advance if filed with Deputy supervisor (District office) or five (5) days in advance if filed with the Commission (Austin).
- Rule 23 adds: "Damaged wells" must be plugged and abandoned immediately.

Passage of Rule 10: February 1, 1934:

- Plugging required for well inactive for 20 days.
- Place cement plugs through tubing or drill pipe under circulation, i.e. by today's "pump and plug" method.
- Fill well from total depth (TD) to ground surface with 10 lb/gallon mud laden fluid (today, 9.5 ppg mud is specified).
- 20 foot cement plug required (10 ft above to 10 ft below) at top of high pressure gas or water zones.
- In addition:
  - Plug inside cemented production casing: cement plug through at least 50 ft above casing shoe.
  - Plug inside un-cemented production casing: cement plug through entire zone before breaking casing shoe seal.
  - Plug for wells with liners to be left in place: Cement plug through liner to 10 ft above top of liner.
  - Plug for dry holes without casing, or any high pressure gas or water zones: 10 ppg mud-laden fluid from TD to ground surface.

Passage of Rule 12 (first appeared in Circular 16-B on May 15, 1934):

- Surface casing must be set and cemented through all fresh water sands.
- Production casing must be cemented with enough cement to fill the annulus behind the casing to a point 600 feet above the casing shoe.
- Production casing must be pressure tested to a pressure equivalent to the hydrostatic pressure of the fluid filled casing (0.43 psi times the depth in feet to the top of zone, with

a 2,000 psi maximum).

Passage of Rule 55, (March 19, 1956):

- Requires that all operations connected with oil and/or gas exploration, injection and disposal of fluids shall be carried out such that no pollution of the streams and water courses of this State, including sub-surface, will occur as the result of the escape or release of crude petroleum oil, gas, salt water or other mineralized waters from such exploratory wells.

Memorandum dated May 30, 1957 (later became Rule 15 in 1964):

- Set and cement surface casing through all fresh water sands.
- Surface casing shall remain in place at time of plugging and abandonment.
- Exceptions granted for:
  - 1) "short surface casing" with DV tool cemented through fresh water;
  - 2) long string if cemented total depth to ground surface.
- Plugging requires 100 foot cement plug (50 foot above and below) at base fresh water, and 100 foot plug (50 foot above and below) at shoe of "short" surface casing.

Passage of Rule 16, (circa May 30, 1959):

- File a completion report (Form W-2) and log, within 30 days of completion, deepening, or workover of well.

Recodification of RRC rules, (June 1, 1964):

- The RRC adopts a recompilation of its statewide rules. Existing statewide rules are merged with various statewide orders, memoranda, and instructions into one entity.

Passage of Rule 14, (January 1, 1967):

- File application to plug, with proposed plugging procedure, 5 days before plugging.
- File plugging report within 30 days of plugging.
- Cementer's affidavit required with plugging report.
- Manner of plugging:
  - 100 foot cement plug required above each set of perforations (district director may allow bridge plugs).
  - 100 foot cement plug (50 foot above and below) at surface casing shoe if production casing is pulled.
  - 100 foot cement plug (50 foot above and below) at "short" surface casing shoe, tagged by tubing or drill pipe, if necessary.

Passage of Rule 8, (effective January 1, 1969):

- Merges Rule 20 with Rule 55.
- Rule 20: almost verbatim of the 1911 version.
- Rule 55: condensed and rewritten, but essentially the same.